REMARKS

The present application was filed on February 23, 2004 with claims 1-20. In the outstanding Office Action dated May 17, 2005, the Examiner has: (i) withdrawn the restriction requirement set forth in the previous Office Action dated April 4, 2005; (ii) objected to the drawings; (iii) rejected claims 1, 2, 5-10, 14 and 17-20 under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 5,955,781 to Joshi et al. (hereinafter "Joshi"); (iv) rejected claims 3, 4, 11, 12, 15 and 16 under 35 U.S.C. §103(a) as being unpatentable over Joshi; and (v) rejected claim 13 under §103(a) as being unpatentable over Joshi in view of admitted prior art (APA).

In this response, FIGS. 1A and 1B of the drawings have been amended. Claim 11 has been canceled, and therefore the rejection of this claim is rendered moot. Additionally, claims 1, 17 and 20 have been amended. Applicants traverse the §103(a) rejections of the claims for at least the reasons set forth below. Applicants respectfully request reconsideration of the present application in view of the above amendments and the following remarks.

An acknowledgment of the receipt of formal drawings filed on March 29, 2004 in the present application is respectfully requested.

FIGS. 1A and 1B have been amended in a manner which is believed to address the Examiner's objection to the drawings. Specifically, the legend "Prior Art" has been added to each of FIGS. 1A and 1B, as suggested by the Examiner. A replacement Sheet 1, which includes FIGS. 1A, 1B and 2, is attached herewith, along with a corresponding Annotated Sheet Showing Changes. Accordingly, Applicants respectfully request withdrawal of the objection to the drawings.

Claims 1, 2, 5-10, 14 and 17-20 stand rejected under §102(b) as being anticipated by Joshi. With regard to independent claims 1, 17 and 20, which are of similar scope, the Examiner contends that Joshi discloses all of the elements set forth in the subject claims. Applicants have amended claims 1, 17 and 20 to incorporate the features of claim 11, and thus further distinguish the claimed invention from the prior art of record. Specifically, claim 1, as amended, further defines the at least one channel, which is substantially filled with one or more layers of a thermally conductive material, as being formed "substantially entirely through a length of the device between opposing sides of the device, so as to reduce a possibility of damage resulting, at least in part, from a mismatch in coefficients of thermal expansion between a material forming the semiconductor substrate and the

IN THE DRAWINGS

The attached sheet of formal drawings, which includes FIGS. 1A, 1B and 2, replaces corresponding Sheet 1 of formal drawings filed on March 29, 2004, which includes FIGS. 1A, 1B and 2.

thermally conductive material" (emphasis added). Applicants assert that the prior art fails to teach or suggest at least this feature of the claimed invention.

Joshi discloses a thermal conductor structure having "embedded diamond fins 102 provided in a backside 104 of a substrate 106" (Joshi; col. 5, lines 62-64). Although Joshi teaches that the fins (102) are formed by depositing diamond within holes or trenches (108) in the substrate (Joshi; col. 5, lines 46-52), Joshi fails to teach or suggest that the trenches, which the Examiner analogizes to the "at least one channel" recited in the subject claims, are formed "substantially entirely through a length of the at least one integrated circuit device between opposing sides of the at least one integrated circuit device," as set forth in claim 1, as amended. Forming the channel in this manner furnishes additional benefits not addressed by the prior art, namely, to provide relief points in the semiconductor die for the expansion and contraction of the material used to fill the channel due to a possible mismatch between the coefficients of thermal expansion of the substrate and the thermally conductive material filling the channel. This is described, for example, in the present specification, on page 8, lines 16-23.

With regard to claim 11, which has been canceled but whose features have been incorporated into claim 1, the Examiner acknowledges that Joshi fails "to teach at least one channel being formed through a length of the device between opposing sides of the device" (Office Action; page 6, paragraph 2). The Examiner, however, contends that "[t]he determination of parameters such as size/dimension including length/width, height, thickness, spacing, etc. . . . is a subject of routine experimentation and optimization to achieve the desired thermal/electrical performance, speed, reliability and yield" (Office Action; page 6, paragraph 3), and therefore obvious to one skilled in the art. Applicants respectfully disagree with this contention and assert that nowhere in Joshi is there any teaching of a mechanism which addresses the problem of mismatched coefficients of thermal expansion, as set forth in amended claims 1, 17 and 20.

Since it is not an objective or design scheme of the cited prior art reference to reduce damage to the device/die resulting from a mismatch in coefficients of thermal expansion between the substrate and the thermally conductive material, as set forth in the subject claims, there lacks the necessary motivation to modify the teachings of Joshi in order to obtain the claimed invention. Therefore, amended claims 1, 17 and 20 are also believed to be nonobvious in view of the prior art.

For at least the reasons set forth above, Applicants submit that claims 1, 17 and 20, as amended, are patentable over the prior art. Accordingly, favorable reconsideration and allowance of these claims are respectfully solicited.

With regard to claims 2, 5-10 and 14, which depend from claim 1, and claims 18 and 19, which depend from claim 17, Applicants submit that these claims are also patentable over the prior art of record by virtue of their dependency from their respective base claims, which are believed to be patentable for at the least the reasons given above. Furthermore, one or more of these claims define additional patentable subject matter in their own right. For example, claim 9 further defines the at least one channel as being formed using an anisotropic etching process. While the Examiner contends that Joshi discloses such limitation, particularly at column 6, line 52 (Office Action; page 4, first paragraph), Applicants respectfully disagree with this contention and assert that the anisotropic etching to which Joshi refers describes the formation of a buried oxide (BOX) layer, rather than the formation of the trenches. Specifically, Joshi teaches that "[e]tching of BOX layer 212 may be performed by isotropic etching or anisotropic etching" (Joshi; col. 6, lines 50-52).

For at least the above reasons, Applicants submit that claims 2, 5-10, 14, 18 and 19 are patentable over the prior art of record, not merely by virtue of their dependency from their respective base claims, but also in their own right. Accordingly, favorable reconsideration and allowance of claims 2, 5-10, 14, 18 and 19 are respectfully requested.

Claims 3, 4, 11, 12, 15 and 16 stand rejected under §103(a) as being unpatentable over Joshi. Applicants assert that these claims, which depend from claim 1, are patentable over the prior art by virtue of their dependency from claim 1, which is believed to be patentable for at the least the reasons given above. Furthermore, one or more of these claims define additional patentable subject matter in their own right. For example, claim 12 further defines the thermally conductive material as having "a coefficient of thermal expansion that is substantially matched to a coefficient of thermal expansion of the substrate." Applicants assert that the prior art fails to teach or suggest such a feature.

With regard to claim 12, the Examiner contends that Joshi teaches using thermally conductive material "including metals such as tungsten, copper, aluminum, etc. . . . to provide improved heat dissipation for the device. Furthermore, the metal such as tungsten has a coefficient

of thermal expansion (CTE) substantially matching to that of the substrate" (Office Action; page 5, paragraph 5). The Examiner further contends that it would have been obvious to a person skilled in the art "to incorporate the thermally conductive material comprising a metal . . . in the channel so that the device processing can be simplified and the material handling/cycle time can be improved in Joshi et al's device" (Office Action; page 5, last paragraph, to page 6, first paragraph). Applicants respectfully disagree with these contentions.

First, Applicants submit that the simplification of "device processing" and "material handling/cycle time, " which the Examiner cites as the motivation for modifying the teachings of Joshi to arrive at the invention set forth in claim 12, are in no way related to an objective of the claimed invention, namely, "to reduce a possibility of damage resulting, at least in part, from a mismatch in coefficients of thermal expansion between a material forming the semiconductor substrate and the thermally conductive material." Joshi makes no reference to selecting the thermally conductive material so as to match the coefficient of thermal expansion of the substrate. Instead, Joshi states, as the sole objectives of the invention, that "[t]hermal conductors having high thermal conductivities and low electrical conductivities are preferred since these materials can provide electrical isolation of semiconductor devices while reducing detrimental thermal effects due to electronic activity" (Joshi; col. 4, lines 26-30).

Applicants assert that, since it is not an objective or design scheme of the cited prior art to reduce damage to the device/die resulting from a mismatch in coefficients of thermal expansion between the substrate and the thermally conductive material, there lacks the necessary motivation to modify the teachings of Joshi in order to obtain the claimed invention, as is required in order to sustain a *prima facie* case of obviousness against the subject claims. "The question of motivation is material to patentability, and could not be resolved on subjective belief and unknown authority." *In re Sang-Su Lee*, 277 F.3d 1338, 1343, 1344 (Fed. Cir. 2002). The numerous body of case law requires that "particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected these components for combination in the manner claimed." *In re Kotzab*, 217 F.3d 1365, 1371 (Fed. Cir. 2000).

For at least the above reasons, Applicants submit that claims 3, 4, 11, 12, 15 and 16 are patentable over the prior art of record, not merely by virtue of their dependency from their respective

base claims, but also in their own right. Accordingly, favorable reconsideration and allowance of claims 3, 4, 11, 12, 15 and 16 are respectfully requested.

Claim 13 stands rejected under §103(a) as being unpatentable over Joshi, in view of admitted prior art. Applicants submit that claim 13, which depends from claim 1, is patentable over the prior art by virtue of its dependency from claim 1, which is believed to be patentable for at the least the reasons given above. Accordingly, favorable reconsideration and allowance of claim 13 is respectfully requested.

In view of the foregoing, Applicants believe that pending claims 1-10 and 12-20 are in condition for allowance, and respectfully request withdrawal of the §102 and §103 rejections.

Respectfully submitted,

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Wayne L. Ellenbogen
Attorney for Applicant(s)
Reg. No. 43,602
Ryan, Mason & Lewis, LLP
90 Forest Avenue
Locust Valley, NY 11560
(516) 759-7662

Attachment(s): Replacement Sheet of Formal Drawings